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Edie et al.

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(54) **CLOSURE WITH ROTATION-INHIBITING PROJECTION**

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CPC ***B65D 41/0471*** (2013.01); ***B65D 41/0421*** (2013.01); *B65D 2251/023* (2013.01); *B65D 2251/06* (2013.01); *B65D 2251/20* (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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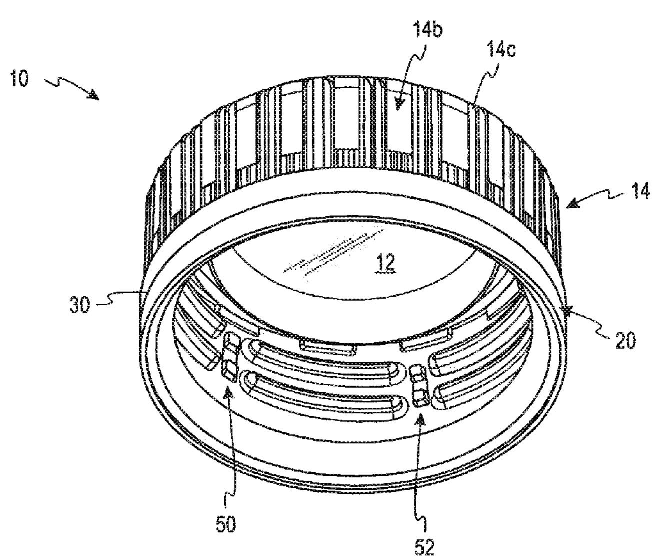
(57) **ABSTRACT**

A closure includes first and second closure portions. The first closure portion includes a polymeric top wall portion and an annular skirt portion. The skirt portion includes exterior and interior surfaces. The interior surface includes an internal thread formation for mating engagement with an external thread formation of a container and at least one rotation-inhibiting projection. The rotation-inhibiting projection is located to contact the external thread formation. The rotation-inhibiting projection is in the general shape of the letter "C" prior to engagement with the external thread formation of the container. The second closure portion includes a polymeric tamper-evident band.

16 Claims, 5 Drawing Sheets



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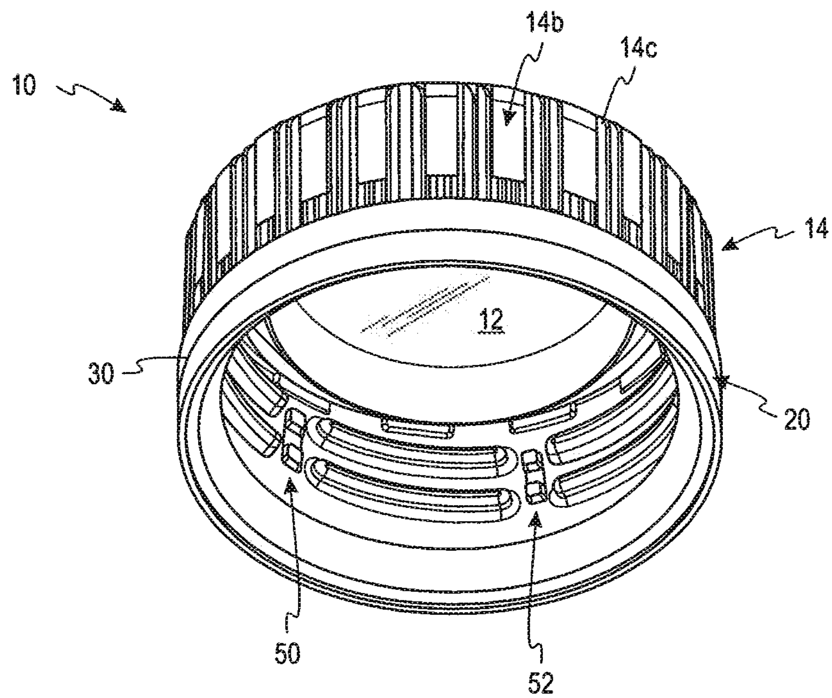


Fig. 1

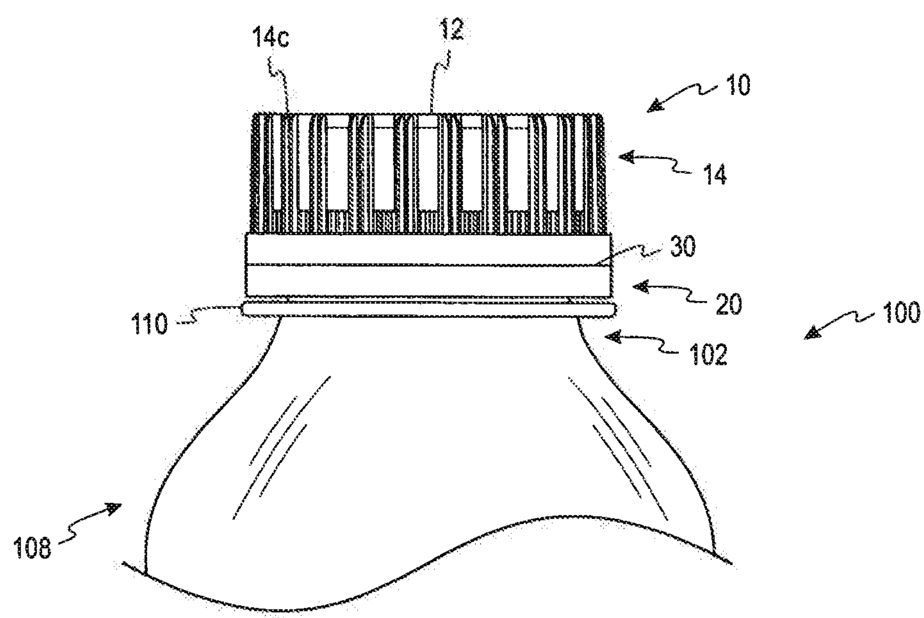


Fig. 2

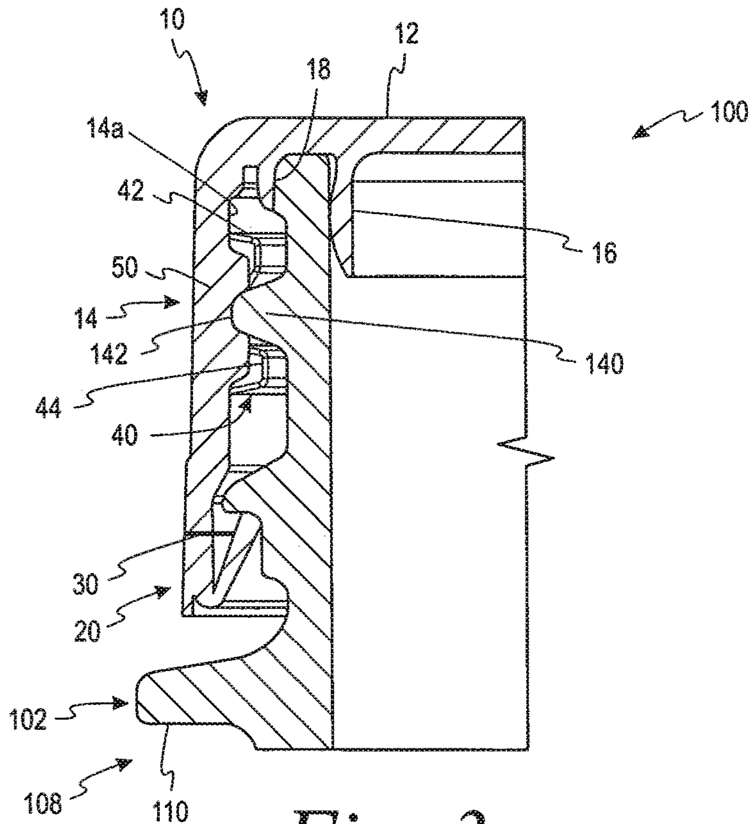

10
12
18
100
14a
42
16
50
14
142
140
44
40
30
20
102
108
110

Fig. 3

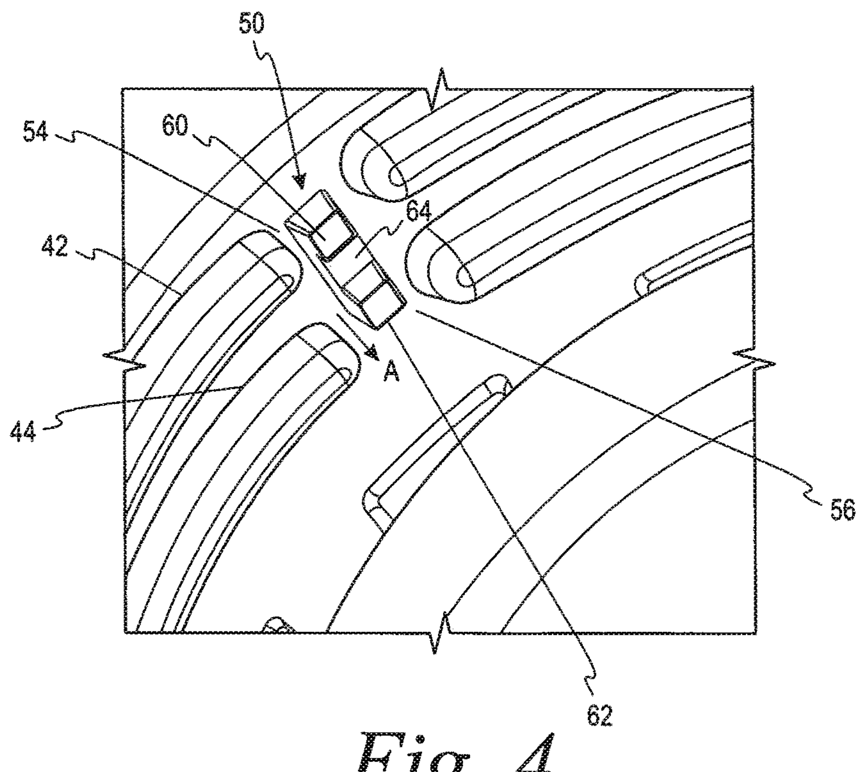

50
54
60
64
42
A
44
56
62

Fig. 4

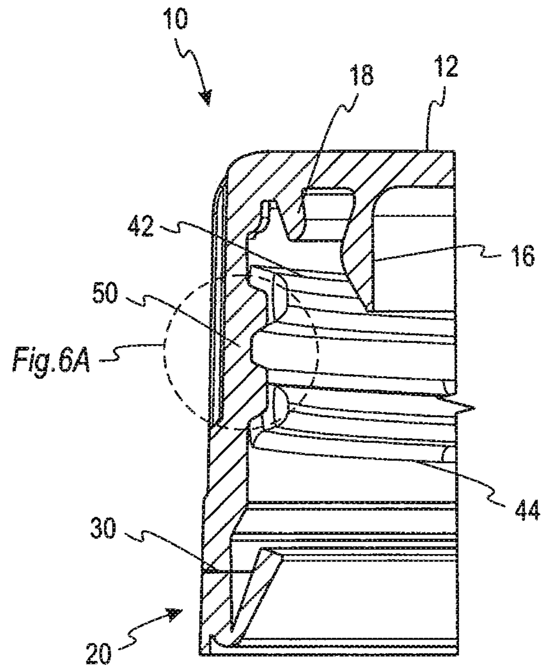


Fig. 5A

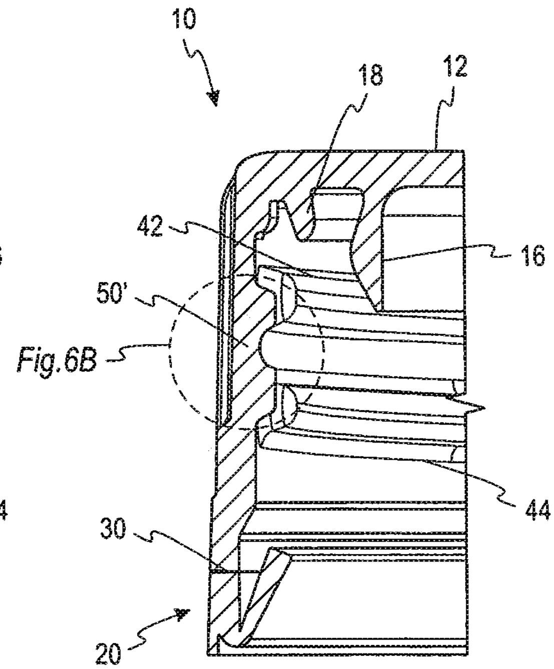


Fig. 5B

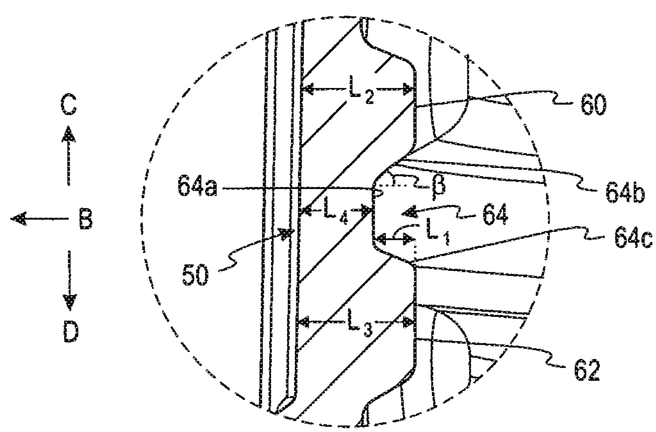


Fig. 6A

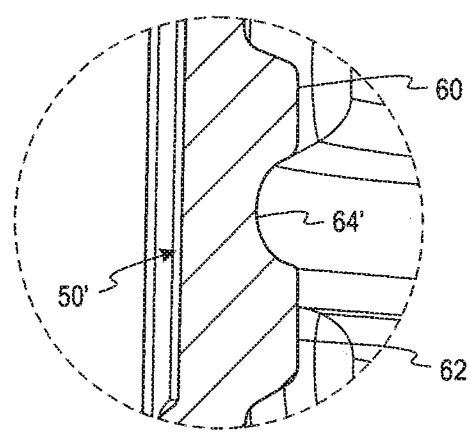
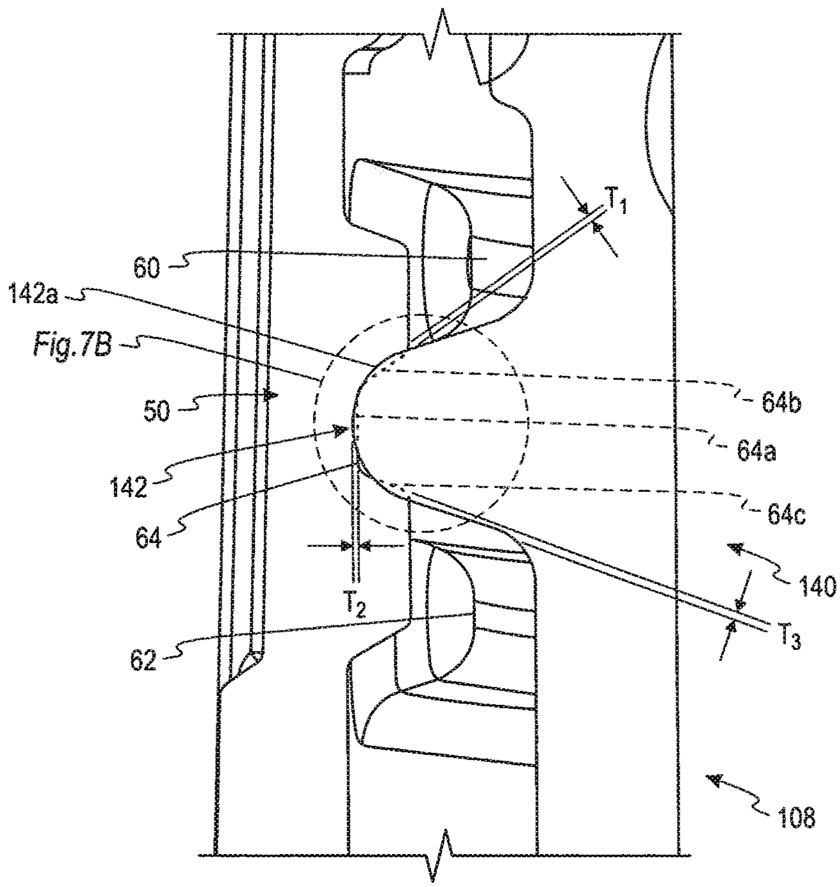
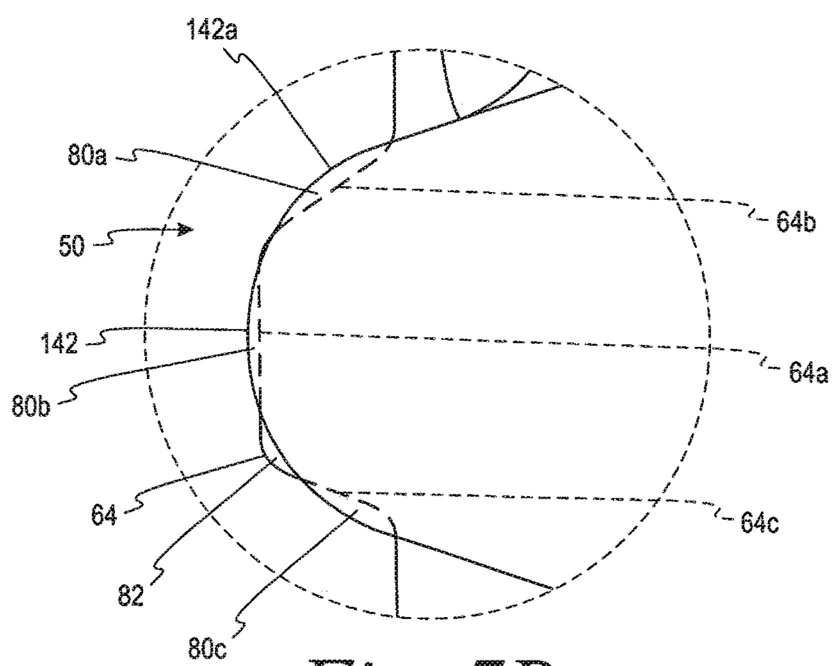


Fig. 6B



T1
60
142a
Fig.7B
50
64b
64a
142
64
64c
140
T3
T2
62
108

Fig. 7A



142a
80a
50
64b
142
64a
80b
64
64c
82
80c

Fig. 7B

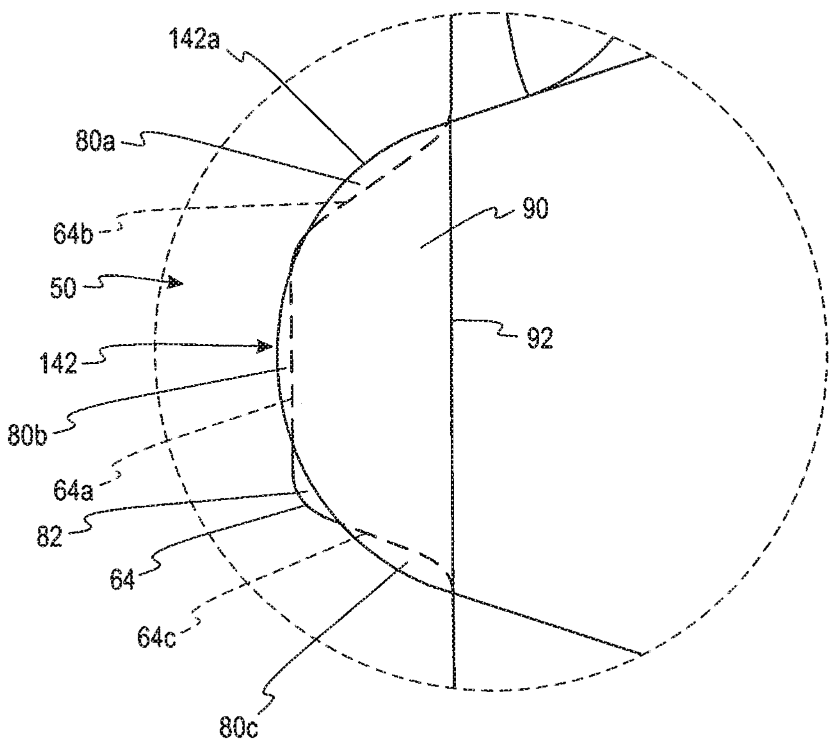


Fig. 7C

CLOSURE WITH ROTATION-INHIBITING PROJECTION

FIELD OF THE INVENTION

The present invention relates generally to a polymeric closure for a package. More specifically, the present invention relates to a polymeric closure with at least one rotation-inhibiting projection.

BACKGROUND OF THE INVENTION

Polymeric closures have been used in many applications over the years in conjunction with containers. The polymeric closures are adapted to thread on and off of the container. One issue with polymeric closures in this area is controlling the speed of the unthreading of the closure from the container by a user. This is typically more important in applications having pressurized container contents such as carbonated soft drinks.

One application for controlling the speed of the unthreading of the closure from the container involves using a speed bump. The problem with using existing larger speed bumps is the possibility of the closure or container getting distorted during application or removal due to a variety of factors that influence how the closure and container interact. In some processes, existing larger speed bumps may also potentially flash material onto a finish of the container that may affect the release of the closure from a mold. Having speed bumps being smaller is typically not as effective since the drag on the finish thread is lessened, resulting in the unthreading being faster than desired.

It would be desirable to provide a closure that addresses these above-noted situations, while still performing other desirable properties of a closure.

SUMMARY

According to one embodiment, a closure includes a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion. The polymeric annular skirt portion depends from the polymeric top wall portion. The annular skirt portion includes an exterior surface and an interior surface. The interior surface of the annular skirt portion includes (a) an internal thread formation for mating engagement with an external thread formation of a container and (b) at least one rotation-inhibiting projection. The at least one rotation-inhibiting projection is located to contact the external thread formation of the container. The at least one rotation-inhibiting projection is in the general shape of the letter "C" prior to engagement with the external thread formation of the container. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is at least partially detachably connected to the polymeric annular skirt portion by a frangible connection. The closure has an unopened position and an opened position. The opened position occurring when the tamper-evident band has been at least partially broken from the polymeric annular skirt portion.

According to another embodiment, a closure includes a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an exterior surface and an interior surface. The interior surface of the annular skirt portion includes (a) an internal thread formation for mating engagement with an external thread formation of a container and (b) at least one rotation-inhibiting projection. The at least one rotation-inhibiting projection is located to contact the external thread formation of the container. The at least one rotation-inhibiting projection includes a first projection, a second projection and a valley located between the first and second projections prior to engagement with the external thread formation of the container. The projections extend from the interior surface of the annular skirt portion. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is at least partially detachably connected to the polymeric annular skirt portion by a frangible connection. The closure has an unopened position and an opened position. The opened position occurs when the tamper-evident band has been at least partially broken from the polymeric annular skirt portion.

According to one method, a package is formed. A closure is provided including a first closure portion and a second closure portion. The first closure portion includes a polymeric top wall portion and a polymeric annular skirt portion depending from the polymeric top wall portion. The annular skirt portion includes an exterior surface and an interior surface. The interior surface of the annular skirt portion includes (a) an internal thread formation for mating engagement with an external thread formation of a container and (b) at least one rotation-inhibiting projection. The at least one rotation-inhibiting projection is located to contact the external thread formation of the container. The second closure portion includes a polymeric tamper-evident band. The tamper-evident band depends from and is at least partially detachably connected to the polymeric annular skirt portion by a frangible connection. The closure has an unopened position and an opened position. The opened position occurs when the tamper-evident band has been at least partially broken from the polymeric annular skirt portion. A container is provided. The container includes a neck portion having the external thread formation. The external thread formation includes a first finish lead such that interference is formed by the surface area of the at least one rotation-inhibiting projection and a surface area of the first finish lead. The total amount of interference between a surface area of the at least one rotation-inhibiting projection and a surface area of the first finish lead is less than about 30%. The closure and the container are threaded to form the package.

The above summary is not intended to represent each embodiment or every aspect of the present invention. Additional features and benefits of the present invention are apparent from the detailed description and figures set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

FIG. **1** is a bottom perspective view of a closure in an unopened position according to one embodiment.

FIG. **2** is a front view of a package including the closure of FIG. **1** and a container according to one embodiment.

FIG. **3** is a generally cross-sectional partial side view of the package of FIG. **2**.

FIG. **4** is a generally top perspective view of a rotation-inhibiting projection of the closure of FIG. **1** according to one embodiment.

FIG. **5**A is a cross-sectional partial side view taken along a rotation-inhibiting projection of the closure of FIG. **1** before being threaded onto a container.

FIG. **5**B is a cross-sectional partial side view taken along a rotation-inhibiting projection of the closure of FIG. **1** after being threaded onto a container.

FIG. **6**A is an enlarged view of generally circular area FIG. **6**A in FIG. **5**A.

FIG. **6**B is an enlarged view of generally circular area FIG. **6**B in FIG. **5**B.

FIG. **7**A is an enlarged cross-sectional partial side view without cross-hatching depicting interference between a rotating-inhibiting projection and a container finish according to one embodiment.

FIG. **7**B is an enlarged view of generally circular area FIG. **7**B in FIG. **7**A.

FIG. **7**C is an enlarged view of generally circular area FIG. **7**B in FIG. **7**A showing interference of the total amount of surface area of the rotating-inhibiting projection to the finish of the container.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that it is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

FIG. **1** illustrates a polymeric closure **10** according to one embodiment of the present invention. The closures are configured to be placed on a container or bottle that contain product. The product is typically a liquid product, but also may be a solid product or a combination of a liquid and solid product. The polymeric closure **10** of FIG. **1** is generally cylindrically shaped. The polymeric closure **10** of FIG. **1** is a one-piece closure assembly. It is contemplated that the closure may be a two-piece closure. It is contemplated that the closure may be of other shapes and dimensions.

Referring to FIGS. **1**-**3**, the polymeric closure **10** includes a polymeric top wall portion **12**, a polymeric annular skirt portion **14**, a polymeric continuous plug seal **16** (FIG. **3**), an outer seal **18** (FIG. **3**) and a polymeric tamper-evident band **20**. The polymeric annular skirt portion **14** depends from the polymeric top wall portion **12**.

As shown in FIG. **3**, the polymeric continuous plug seal **16** depends from the polymeric top wall portion **12** and provides a sealing mechanism. The outer seal **18** depends from the polymeric top wall portion **12** and also provides a sealing mechanism. The continuous plug seal **16** and the outer seal **18** are spaced from an interior surface **14***a* of the polymeric annular skirt portion **14**.

In another embodiment, the closure may include other sealing mechanisms. For example, the closure may include a polymeric lining material that provides a seal to the closure. This would be a two-piece closure. Non-limiting examples of a closure including a polymeric liner and a polymeric disk can be found at U.S. Publication No. 2018/0099795, which is incorporated by reference herein in its entirety. In this embodiment, the closure would be formed from separate components, but would function as the one-piece closure discussed except with a different sealing mechanism. In another embodiment, the closure may include either a polymeric outer seal or a continuous plug seal. It is contemplated that the closure may include other sealing mechanisms.

As shown in, for example, FIGS. **1**-**3**, the polymeric tamper-evident band **20** depends from and is at least partially detachably connected to the polymeric annular skirt portion **14** by a frangible connection **30**. Once the closure moves from an initial closed position (see, e.g., FIG. **2**) to an open position, the polymeric tamper-evident band **20** is at least partially detached and typically is fully detached from the polymeric annular skirt portion **14**. The tamper-evident band **20** works in conjunction with the container to indicate to a user that the contents of the container may have been accessed. More specifically, the tamper-evident band **20** is designed to at least partially separate from the annular skirt portion **14** if a user opens the package by unthreading and removing the closure to gain access to the container. In one embodiment, the frangible connection **30** may be formed using scoring or scored lines, notches, leaders, nicks or other lines of weaknesses.

Referring back to FIG. **1**, an outer surface **14***b* of the polymeric annular skirt portion **14** may also include a plurality of ridges **14***c* thereon. The plurality of ridges **14***c* has a contoured shape that assists a user in gripping the closure **10**.

The polymeric annular skirt portion includes an internal thread formation for mating engagement with an external thread formation of a container. Specifically, the polymeric annular skirt portion **14** of FIG. **3** includes an internal thread formation **40** for mating engagement with an external thread formation of a container. The internal thread formation **40** includes a first closure thread segment **42** and a second closure thread segment **44**. The thread development is typically discontinuous. The thread segments in the polymeric annular skirt portion **14** from the beginning to the end are helical in this embodiment.

There may be applications where there are not multiple thread segments in the closure, but they are typically used for packages holding less than 45 psi. It is contemplated that the thread closure turns may be continuous, especially in those applications with packages having less than 45 psi. It is also contemplated that the internal thread formation of the closure may differ from a helical thread formation. It is also contemplated that other internal thread formations may be used in the closure.

Referring to FIGS. **4** and **5**A, a rotation-inhibiting projection or speed bump **50** is shown according to one embodiment. The rotation-inhibiting projection **50** of FIG. **4** is shown as being located between gaps or spaces **54**, **56** between the first closure thread segment **42** and the second closure thread segment **44**, respectively. The rotation-inhibiting projection is also located in a generally axially direction (direction of arrow A in FIG. **4**) with respect to the first closure thread segment **42** and the second closure thread segment **44**. The rotation-inhibiting projection **50** is positioned to contact a finish thread of a container when the closure is threaded onto or unthreaded from the container.

The function of the rotation-inhibiting projection **50** is to form a slight resistance during the unthreading of the closure from the container by a user. The rotation-inhibiting projection **50** assists in preventing or inhibiting the closure from spinning quicker than desired. This is especially desired in instances where the contents of the container are pressurized such as carbonated soft drinks.

FIGS. **4** and **5**A depict exactly one rotation-inhibiting projection **50**. It is contemplated that a plurality of rotation-inhibiting projections may be used in one embodiment. The number of rotation-inhibiting projections used in a closure generally varies from about 1 to about 10. More specifically, the number of rotation-inhibiting projections used in a closure is generally from about 2 to about 8, from about 2 to about 6 or, more specifically, from about 4 to about 6. In one non-limiting example, FIG. **1** depicts a closure **10** with two rotation-inhibiting projections **50**, **52** being shown and four other rotation-inhibiting projections not been shown. The rotation-inhibiting projections are shown in vent locations in the thread development. Thus, in closure **10** of FIG. **1**, there are a total of six rotation-inhibiting projections.

The shape of the rotation-inhibiting projection **50** shown in FIGS. **4**, **5**A, **6**A is the shape before the closure **10** is threaded onto a container. The process of threading the closure on a container typically occurs via machinery. During the process of threading the closure on the container, the material forming the rotation-inhibiting projection **50** will be conformed generally around the finish thread of the container.

The rotation-inhibiting projection **50'** is shown in FIGS. **5**B and **6**B after the closure has been threaded onto the container. The shape of valley **64'** is slightly more rounded as compared to the valley **64** in FIG. **6**A. The valley **64'** is shaped by the finish thread as the closure **10** has been threaded onto the container. Once fully applied, the rotation-inhibiting projection looks like the thread has gone through it.

Referring back to FIGS. **4** and **6**A, the rotation-inhibiting projection **50** includes a first projection **60**, a second projection **62** and a valley **64** between the first and second projections **60**, **62**. The valley **64** is generally aligned to contact the finish thread of the container when the closure is being threaded onto the container. The shape of the valley **64** is desirably similar to the shape of the finish thread of the container. This assists in both threading on the closure to the container and also allows the finish thread to travel through at a desired resistance while still maintaining a desired contact with the closure thread during the unthreading process. The shape and size of the rotation-inhibiting projection desirably prevents or inhibits the closure from spinning too quickly (spinning without manual resistance) during the unthreading of the closure from the container. The shape and size also reduces or inhibits damage to either the closure or the container.

Referring specifically to FIG. **6**A, the valley **64** includes surfaces **64***a*, **64***b*, **64***c* that are integrally connected with each other. The valley **64** is in a general "U" shape. The surfaces **64***b*, **64***c* of FIG. **6**A extend generally inwardly to the surface **64***a* as shown in FIG. **6**A. In other words, the surfaces **64***b*, **64***c* extend into the interior of the closure and in the direction of arrow B. The surface **64***b* flares upwardly with respect to the surface **64***a* (direction of arrow C in FIG. **6**A), while the surface **64***c* flares downwardly with respect to the surface **64***a* (direction of arrow D in FIG. **6**A). The surface **64***a* is shown as being generally vertical in the orientation of FIG. **6**A. The angles of surfaces **64***b*, **64***c* are generally from about 15 to about 45 degrees. This is shown in FIG. **6**A with respect to angle β.

The rotation-inhibiting projection **50** includes the first projection **60**, the second projection **62** and the valley **64**. The rotation-inhibiting projection **50** is in the shape of the general letter "C".

It is contemplated that the at least one rotation-inhibiting projection may contact at least one closure thread segments in another embodiment. For example, rotation-inhibiting projections may contact one or more of the closure thread segments. It is desirable in higher-pressured applications to maintain at least some venting channels to assist in releasing the pressure when opening the container.

As shown in FIG. **6**A, the length L**1** of the valley **64** is less than the lengths L**2** and L**3** of the rotation-inhibiting projections **60**, **62**. The length L**1** is generally from about 0.025 inches to about 0.035 inches and, more specifically, from about 0.025 inches to about 0.030 inches. The length L**2** is generally from about 0.055 inches to about 0.080 inches and, more specifically, from about 0.060 inches to about 0.075 inches. The length L**3** is generally from about 0.055 inches to about 0.080 inches and, more specifically, from about 0.060 inches to about 0.075 inches. The length L**4** is generally from about 0.030 inches to about 0.045 inches and, more specifically from about 0.030 inches to about 0.040 inches.

For example, a depth of the valley (e.g., length L**1** in FIG. **6**A) is generally less than 25% of the depth of a finish thread of the container. For example, if a finish thread is 60 mils, then the depth of the valley should be from 2 to 15 mils. The depth of the valley (e.g., length L**1** in FIG. **6**A) is generally from about 15 to about 20% of the depth of a finish thread of the container. For example, if a finish thread is 60 mils, then the depth of the valley should be from 9 to about 12 mils. The depth of the valley (e.g., length L**1** in FIG. **6**A) is generally from about 5 to about 25% of the depth of a finish thread of the container and, more specifically, from about 5 to about 20%. The depth of the valley (e.g., length L**1** in FIG. **6**A) is even more specifically from about 5% to about 15% of the depth of a finish thread of the container and, even more specifically, from about 10% to about 15%.

The rotation-inhibiting projection(s) of the present invention (e.g., rotation-inhibiting projection **50** in FIGS. **4**A and **6**A) is beneficial for several reasons. The rotation-inhibiting projection desirably uses less material, which reduces cost. The amount of material that forms the rotation-inhibiting projection to be displaced during the threading of the closure onto the container is reduced, which allows the rotation-inhibiting projection to retain more of its original shape. By having less material, the process of threading the closure onto the container is also improved, especially across a wider range of hand- and machine-application conditions. This produces a more consistent performance from package to package. The rotation-inhibiting projection also allows the process to use less torque in threading the closure onto the container.

The frangible connection **30** may be formed by molded-in-bridges in one embodiment. The molded-in-bridges are typically formed using a feature in the mold. In another embodiment, the frangible connection may be formed using scoring or scored lines, notches, leaders, nicks or other lines of weaknesses.

The closure **10** of the present invention may be used with a container **108** used to form a package **100** of FIGS. **2** and **3**. Referring to FIG. **3**, generally cross-sectional partial side views of the package **100** are shown. Specifically, FIG. **3** depicts a portion of the container **108** that includes a neck portion **102** that defines an opening. The neck portion **102** of the container **108** includes an external thread formation **140** and a continuous outer ring **110**. The external thread formation **140** includes a first finish lead **142** and a second finish lead (not shown). The external thread formation **140** (first finish lead **142** and second finish lead) engages with the corresponding internal thread formation **40** (the closure thread segments **42**, **44**) to seal the package **100**.

The first finish lead **142** begins near the open end of the container **108** and extends in a helical fashion to a second position that is closer to the closed end of the container.

Similarly, the second finish lead starts closer to the open end of the container **108** and extends in a helical fashion to a second position that is closer to the closed end of the container. Each of the first and second finish leads is continuous. The first positions of the first and second finish leads are typically located roughly 180 degrees apart from each other and, thus, begin on opposing sides of the neck portion **102** of the container **108**. When opening the container **108**, the first closure thread segment **42** is desirably in contact with the first finish lead **142** and the second closure thread segment **44** is desirably in contact with the second finish lead. It is contemplated that the external thread formation of the container may have discontinuous leads.

It is contemplated that the external thread formation of the container may be different than that disclosed with respect to the container **108**.

The continuous outer ring **110** assists in positioning the tamper-evident band **20** if the annular skirt portion **14** is unthreaded from the neck **102** of the container **108** by the breaking of the frangible connection **30**.

A non-limiting example of interference of the surface area between a rotating-inhibiting projection and a container finish is shown in FIGS. **7**A, **7**B. FIG. **7**A includes the external thread formation **140** with the first finish lead **142**, and the rotating-inhibiting projection **50** with the first and second projections **60**, **62** and the valley **64** therebetween. The portion of the original surfaces of the valley **64** (the surfaces **64***a*, **64***b*, and **64***c*) that are interfered by the first finish lead **142** are shown in dashed lines. These are the surfaces of the valley **64** before being contacted by an exterior surface **142***a* of the first finish lead **142**. Referring back to FIG. **7**B, the interferences of the surfaces **64***a*, **64***b*, and **64***c* are shown with respect to the exterior surface **142***a* in more detail. Specifically, there are three interference areas **80***a*, **80***b*, **80***c* shown in FIG. **7**B. FIG. **7**B also shows an open area **82** between the exterior surface **142***a* and the surfaces **64***a* and **64***b*. It is noted that on the initial threading of the first finish lead **142** into the rotating-inhibiting projection **50**, excess material from the interference areas **80***b*, **80***c* will be displaced and assist in filling in the open area **82** such that this open area will not remain after the first finish lead **142** is threaded into the rotating-inhibiting projection **50**.

The thickness T1 of interference area **80***a* at its maximum point in FIG. **7**A is generally from about 0.0002 inches to about 0.0008 inches and, more specifically, from about 0.0003 inches to about 0.0006 inches. The thickness T2 of interference area **80***b* is generally from about 0.0002 inches to about 0.0008 inches and, more specifically, from about 0.0003 inches to about 0.0006. The thickness T3 of interference area **80***c* is generally from about 0.0002 inches to about 0.0008 inches and, more specifically, from about 0.0003 inches to about 0.0006 inches.

In one embodiment, the interference of the total amount of surface area of the rotating-inhibiting projection **50** (e.g., surfaces **64***a*, **64***b*, and **64***c* of FIG. **6**A) to the finish of the container should be less than about 30% in one embodiment and less than about 20% or about 10% in other embodiments. Typically, the interference of the total amount of surface area of the rotating-inhibiting projection (e.g., surfaces **64***a*, **64***b*, and **64***c* of FIG. **6**A) to the finish of the container ranges from about 10 to about 30% and, more specifically, from about 10 to about 25%. As discussed above, this assists in the rotation-inhibiting projection retaining more of its original shape, leads to less distortion and uses less polymeric material.

Referring to FIG. **7**C, an example of how to calculate the interference of the total amount of surface area of the rotating-inhibiting projection **50** (e.g., surfaces **64***a*, **64***b*, and **64***c* of FIG. **6**A) to the finish of the container is shown in one non-limiting example. FIG. **7**C shows an area **90** that is bounded by an added line **92** and the exterior surface **142***a* of the first finish lead **142**. The total amount of interference in areas **80***a*, **80***b* and **80***c* are added up and divided by the area **90**. This gives the interference of the total amount of surface of the rotating-inhibiting projections to the finish of the container.

The closures of the present invention may include an oxygen-scavenger material. This oxygen-scavenger material may be distributed within the closure or may be a separate layer. The oxygen-scavenger material may be any material that assists in removing oxygen within the container, while having little or no effect on the contents within the container.

Alternatively, or in addition to, the closures may include an oxygen-barrier material. The oxygen-barrier material may be added as a separate layer or may be integrated within the closure itself. The oxygen-barrier materials assist in preventing or inhibiting oxygen from entering the container through the closure. These materials may include, but are not limited to, ethylene vinyl alcohol (EVOH). It is contemplated that other oxygen-barrier materials may be used in the closure.

Additionally, it is contemplated that other features may be included in the closure described above. For example, U.S. Publication No. 2018/009979, U.S. Publication No. 2017/0349336, U.S. Pat. Nos. 9,126,726, 9,085,385, 8,763,830, 8,485,374, U.S. Publication No. 2009/0045158 and U.S. Pat. No. 6,123,212 all include features that may be incorporated in the closures of the present invention. All of these references are hereby incorporated by reference in their entireties.

The top wall portion **12**, the annular skirt portion **14**, and the tamper-evident band **20** are made of polymeric material. The top wall portion **12**, the annular skirt portion **14**, and the tamper-evident band **20** are typically made of an olefin (e.g., polyethylene (PE), polypropylene (PP)), polyethylene terephthalate (PET) or blends thereof. One example of a polyethylene that may be used in high density polyethylene (HDPE). It is contemplated that the top wall portion, the annular skirt portion, the tamper-evident band may be made of other polymeric materials. The tamper-evident band **20** is typically made of the same materials as the top wall portion **12**, and the annular skirt portion **14**.

The closures are typically formed by processes such as injection or compression molding, extrusion or the combination thereof.

The container **108** is typically made of polymeric material. One non-limiting example of a material to be used in forming a polymeric container is polyethylene terephthalate (PET), polypropylene (PP) or blends using the same. It is contemplated that the container may be formed of other polymeric or copolymer materials. It is also contemplated that the container may be formed of glass. The container **108** typically has an encapsulated oxygen-barrier layer or oxygen barrier material incorporated therein.

To open the container **108** and gain access to the product therein, the closure **10** is unthreaded by turning the closure **10** with respect to the container **108**. After the closure has been unthreaded, the closure **10** can be removed from the container **108**. When using this method, the tamper-evident band **20** is at least partially separated from the reminder of the closure **10** via the frangible connection **30**, which indicates that the closure **10** has been unthreaded with respect to the container **108**.

The polymeric closures of the present invention are desirable in both low-temperature and high-temperature applications. The polymeric closures may be used in low-temperature applications such as an ambient or a cold fill. These applications typically include pressurized products such as carbonated soft drinks. It is contemplated that the closure may be used in other applications such as water, sports drinks, and aseptic applications such as dairy products. It is contemplated that other low-temperature applications may be used with the polymeric closures of the present invention.

The polymeric closures of the present invention may be exposed to high-temperature applications such as hot-fill, pasteurization, and retort applications. A hot fill application is generally performed at temperatures around 185° F., while a hot-fill with pasteurization is generally performed at temperatures around 205° F. Retort applications are typically done at temperatures greater than 250° F. It is contemplated that the polymeric closures of the present invention can be used in other high-temperature applications.

What is claimed is:

1. A closure comprising:
- a first closure portion including:
  - a polymeric top wall portion;
  - a polymeric annular skirt portion depending from the polymeric top wall portion, the annular skirt portion including an exterior surface and an interior surface, the interior surface of the annular skirt portion including (a) an internal thread formation for mating engagement with an external thread formation of a container and (b) at least one rotation-inhibiting projection, the at least one rotation-inhibiting projection being located to contact the external thread formation of the container, the at least one rotation-inhibiting projection being in the general cross-sectional shape of the letter "C" prior to engagement with the external thread formation of the container; and
- a second closure portion including:
  - a polymeric tamper-evident band depending from and being at least partially detachably connected to the polymeric annular skirt portion by a frangible connection,
- wherein the closure has an unopened position and an opened position, the opened position occurring when the tamper-evident band has been at least partially broken from the polymeric annular skirt portion.

2. The closure of claim **1**, wherein the at least one rotation-inhibiting projection is a plurality of rotation-inhibiting projections.

3. The closure of claim **2**, wherein the plurality of rotation-inhibiting projections is from about 4 to about 6 rotation-inhibiting projections.

4. The closure of claim **1**, wherein the at least one rotation-inhibiting projection is located generally axially to the internal thread formation.

5. The closure of claim **1**, wherein the at least one rotation-inhibiting projection is spaced from the internal thread formation.

6. The closure of claim **1**, wherein the internal thread formation includes a first closure lead and a second closure lead.

7. The closure of claim **1**, wherein the closure is a one-piece closure.

8. The closure of claim **1**, wherein the closure comprises polyolefins.

9. The closure of claim **1**, wherein the first closure portion further includes a polymeric continuous plug seal depending from the polymeric top wall portion, the continuous plug seal being spaced from an interior surface of the polymeric annular skirt portion.

10. The closure of claim **1**, wherein the first closure portion further includes a polymeric outer seal depending from the polymeric top wall portion.

11. A closure comprising:
- a first closure portion including:
  - a polymeric top wall portion;
  - a polymeric annular skirt portion depending from the polymeric top wall portion, the annular skirt portion including an exterior surface and an interior surface, the interior surface of the annular skirt portion including (a) an internal thread formation for mating engagement with an external thread formation of a container and (b) at least one rotation-inhibiting projection, the at least one rotation-inhibiting projection being located to contact the external thread formation of the container, the at least one rotation-inhibiting projection having a cross-sectional shape including a first projection, a second projection and a valley located between the first and second projections prior to engagement with the external thread formation of the container, the projections extending from the interior surface of the annular skirt portion; and
- a second closure portion including:
  - a polymeric tamper-evident band depending from and being at least partially detachably connected to the polymeric annular skirt portion by a frangible connection,
- wherein the closure has an unopened position and an opened position, the opened position occurring when the tamper-evident band has been at least partially broken from the polymeric annular skirt portion.

12. The closure of claim **11**, wherein the at least one rotation-inhibiting projection is a plurality of rotation-inhibiting projections.

13. The closure of claim **12**, wherein the plurality of rotation-inhibiting projections is from about 4 to about 6 rotation-inhibiting projections.

14. The closure of claim **11**, wherein the at least one rotation-inhibiting projection is located generally axially to the internal thread formation.

15. The closure of claim **11**, wherein the at least one rotation-inhibiting projection is spaced from the internal thread formation.

16. The closure of claim **11**, wherein the closure comprises polyolefins.

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